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COTTON VARIETAL CHARACTERISTICS AFFECTING MECHANICAL PICKING AND GINNING^{1/}

Charles S. Shaw, Gary L. Barker, and Joe E. Clayton^{2/}

A series of yearly experiments was begun at Stoneville in 1962 to establish quantitative measurements of cotton plant characteristics that affect mechanical picking. In discussing plant characteristics as they affect harvester performance, engineers and plant breeders have heretofore commonly relied on qualitative terms, such as "ease of picking," "storm resistance," "open boll," and "high fruiting." Research was done in a series of continuing studies to establish more measurable definitions of desirable plant characteristics for mechanical picking. Although a number of parameters were measured, the primary effort in the early experiments was to relate lock-removal forces to harvesting efficiency.

Six commercial varieties of cotton with distinct differences in stalk and boll characteristics were used in a 3-year study (1962-64) to determine desirable plant and fiber characteristics for mechanical picking and ginning. The varieties were Lankart 57, Acala 4-42, Northern Star 4-11, Deltapine Smooth Leaf, Delfos 9169, and Stoneville 7-A. Lankart 57 and Northern Star 4-11 are classified as storm-resistant varieties, while the other four are open-boll varieties. Lankart and Acala produced the largest bolls and Deltapine Smooth Leaf, the smallest. The average difference in boll diameter was 0.3 inch. Acala 4-42 had the largest stalks and Lankart 57 and Northern Star 4-11, the smallest. Conventional cultural practices were followed throughout each season.

Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of endorsement by the U.S. Department of Agriculture over other products not mentioned.

1/ The research was accomplished as cooperative investigations between the Cotton Mechanization Project and U.S. Cotton Ginning Laboratory, Agricultural Engineering Research Division, Agricultural Research Service, U.S. Department of Agriculture, and the Delta Branch Mississippi Agricultural Experiment Station, Stoneville, Miss., and is a contribution to Regional Cotton Mechanization Project S-2.

2/ Research cotton technologist and agricultural engineers, respectively, Agricultural Engineering Research Division.

The experiment each year consisted of six replications of the six varieties in a latin square arrangement. Each plot was approximately 66 feet long and 8 rows wide, providing a total of 48 rows of each variety for study. The center four rows of each plot were harvested each year with a one-row, tapered spindle picker. A comparison of harvesting efficiency, trash content, moisture content, response to cleaning and ginning, grade, staple length, preharvest loss, yield, and lock-removal forces was made each year.

Preharvest cotton loss was determined each year by removing all cotton from the ground ahead of the picker. Immediately after harvesting, ground and stalk losses were determined separately. Both preharvest and postharvest losses were used in calculating total yield.

For cleaning and ginning tests, it was necessary to combine two replications of each variety of seed cotton into one lot. After the collection of samples for moisture and foreign-matter content determinations, all lots of seed cotton were processed through a typical gin setup normally recommended in the Midsouth area for machine-picked cotton.

Seed cotton samples were also collected for moisture and foreign matter content after the drying and cleaning operation; and lint samples, after the final lint cleaning. Grade and staple-length determinations were made by the USDA Classing Office in Greenwood, Miss.

One hundred open bolls of each variety were gathered and used in determining lock-removal forces in the laboratory. These values were then compared with machine-efficiency and preharvest-loss data. The peak lock-removal force was determined by use of strain gages mounted on a cantilever beam. There was a slight variation in data by variety from year to year, but definite trends were established.^{3/}

1962 Experiments

The six cotton varieties with diverse stalk and boll characteristics were planted on April 26, 1962. The plant population per acre of the varieties 8 weeks after emergence were as follows:

Lankart 57-----	31,951
Acala 4-42-----	43,908
Northern Star 4-11-----	36,068
Deltapine Smooth Leaf-----	35,440
Delfos 9169-----	30,148
Stoneville 7-A-----	29,142

^{3/} Barker, Gary L., Shaw, C. Scott, and Clayton, Joe E. Varietal characteristics affecting mechanical picking. Miss. State Univ. Agr. Expt. Sta. Information Sheet #945, August 1966.

Test Procedures. No measurements were made on boll stem breaking strength or boll size in 1962 because of the rapid opening caused by dry weather. All varieties were defoliated before picking on October 16. New growth occurred on all varieties just before picking.

Table 1 gives the picker efficiency and preharvest losses at the time of picking. Lankart 57 cotton had a very low preharvest loss. It also had a lower picker efficiency due to its tight boll characteristics.

Table 1. Picker efficiency^{1/} and preharvest losses of cotton varieties in field tests, Stoneville, Miss., 1962

Test item	Lankart 57	Acala 4-42	Northern Star 4-11	Deltapine Smooth Leaf	Delfos 9169	Stone- ville 7-A
Picker efficiency ^{2/} percent	73.3	80.9	78.7	81.8	86.0	82.8
Picker efficiency ^{3/} ---do--	70.2	71.6	72.9	73.8	75.7	70.5
Seed cotton, loss per acre:						
Ground-----pounds-----	205	161	169	247	120	161
Stalk-----do-----	180	107	177	98	123	98
Preharvest---do-----	68	176	189	224	216	261
Total-----do-----	452	444	535	569	459	520
Clean seed cotton:						
Yield per acre--pounds--	1595	1610	2069	2219	2100	1873
Yield per acre---bales--	1.16	1.17	1.51	1.62	1.53	1.37

1/ International Harvester 120-A cotton picker; average of 24 replicate lots.

2/ Considering ground and stalk losses.

3/ Considering ground, stalk, and preharvest losses.

Table 2 shows the average peak force required to remove a lock of cotton compared with carpel angle, picker efficiency, and preharvest loss.

Table 2. Average peak force required to remove a lock of cotton compared with average carpel angle, picker efficiency, and preharvest loss, 1962 crop^{1/}

Variety	Peak removal force	Carpel angle	Picker efficiency	Pre-harvest loss	Angle vs. force coefficient of correlation
	Grams	Degrees	Percent	lb./acre	Value
Stoneville 7-A	104.2	173.4	82.8	261	0.242
Deltapine Smooth Leaf	98.3	162.4	81.8	224	.488
Delfos 9169	107.6	160.2	86.0	216	.281
Acala 4-42	111.2	149.6	80.9	176	-.396
Northern Star 4-11	116.8	154.3	78.7	189	-.598
Lankart 57	134.3	146.1	73.3	68	-.204

^{1/} Peak-removal force and carpel-angle values are based on an average of the locks removed from 100 bolls for each variety.

The Delfos 9169 and Stoneville 7-A varieties gave the highest picking efficiency both in the laboratory and field tests, but were highest in preharvest loss along with Deltapine Smooth Leaf. Lankart 57 was by far the lowest in preharvest loss. In regard to picking efficiency vs. yield for the six varieties, increased yield resulted in increased picking efficiency except for Acala 4-42 and possibly Delfos 9169. Seed cotton left on the stalk increased significantly with increased yield for Lankart 57, Northern Star 4-11, and Deltapine Smooth Leaf. The stalk loss increased as ground loss decreased for Northern Star and Stoneville 7-A.

Lankart 57 had the lowest carpel angle and the highest peak removal force. Lankart also had significantly less preharvest loss.

Seed cottons, representing three replications of six different varieties, were mechanically harvested on November 17, 1962, and ginned in the three-stand gin at the U.S. Cotton Ginning Research Laboratory, Stoneville, Miss., on November 18, 1962. The following machinery arrangement was used: Tower drier (200° F.), 6-cylinder cleaner, bur machine, 7-cylinder cleaner, extractor-feeder-cleaner, and double lint cleaning.

Seed cotton foreign matter test results are summarized in table 3.

Table 3. Seed cotton foreign matter content of wagon and feeder samples pertaining to the 6 cotton varieties, 1962 crop.

Seed Cotton Foreign matter content	Lankart 57- ^{1/}	Acala 4-42- ^{1/}	Northern Star 4-11- ^{1/}	Delta-pine Smooth Leaf- ^{1/}	Delfos 9169- ^{1/}	Stone-ville 7-A- ^{1/}	Average, six var- ieties com- bined- ^{2/}
Wagon sample:							
Hulls-----percent---	2.2	1.0	1.6	2.3	1.9	2.5	1.9
Sticks and stems-----do-----	.2	.3	.4	.6	.4	.5	.4
Grass-----do-----	.3	.2	.2	.4	.5	.4	.3
Large leaf----do-----	.4	.8	.6	.7	.8	.6	.6
Small leaf----do-----	1.4	1.5	1.3	1.0	1.3	1.5	1.3
Pin trash----do-----	1.2	1.0	1.1	1.4	1.3	1.6	1.3
Total all foreign matter---percent---	5.7	4.8	5.2	6.4	6.2	7.1	5.8
Feeder sample:							
Hulls-----percent---	.1	---	.1	.2	.2	.2	.1
Sticks and stems-----do-----	.2	.2	.1	--	.3	.2	.2
Grass-----do-----	.2	.2	.2	.2	.2	.3	.2
Large leaf----do-----	.1	.1	.1	.3	.3	.1	.2
Small leaf----do-----	.7	.5	.6	.4	.6	.7	.6
Pin trash----do-----	.2	.2	.2	.2	.4	.3	.2
Total all foreign matter---percent---	1.5	1.2	1.3	1.3	2.0	1.8	1.5

1/ Figures are averages of 6 samples---2 for each of 3 replications.

2/ Figures are averages of 36 samples---6 for each of 6 varieties.

All cottons responded favorably to the overhead cleaning, but the wagon sample foreign matter contents of the Stoneville 7-A, Delfos 9169, and Delta-pine Smooth Leaf varieties were higher than for the other three varieties (table 3). The Deltapine Smooth Leaf, however, came out with the highest grade index value of 99.0, while the Delfos 9169 had the lowest grade index value of 94.0 (table 4). The grade index values averaged 98.0 for the Lankart 57, Acala 4-42, and Northern Star 4-11; the Stoneville 7-A grade-index value averaged 97.0.

Table 4. Classification data, foreign matter content of lint, and moisture content test results associated with the cleaning and ginning of 6 cotton varieties, 1962 crop^{1/}

Variety	Classification		Foreign matter content of lint	Moisture content		
	Grade ^{2/}	Staple length		Wagon sample	Feeder sample	Lint sample
	Index	32nds	Percent	Percent	Percent	Percent
Lankart 57	98.0	33.0	1.37	11.8	9.8	4.0
Acala 4-42	98.0	33.8	1.33	12.5	9.9	4.0
Northern Star 4-11	98.0	33.2	1.59	12.6	9.2	3.9
Deltapine Smooth Leaf	99.0	33.2	1.59	12.0	9.6	3.9
Delfos 9169	94.0	33.3	1.99	13.2	10.2	3.8
Stoneville 7-A	97.0	33.3	1.89	13.2	10.3	4.0

1/ Figures are average of 6 samples - 2 for each of 3 replications.

2/ 100 = Middling; and 94 = Strict Low Middling.

The lower grade index values of the Delfos 9169 and Stoneville 7-A varieties were also reflected in corresponding higher feeder sample and lint foreign matter contents.

1963 Experiments

The plant population of the varieties 10 weeks after planting in 1963 were as follows:

Lankart 57-----	36,590
Acala 4-42-----	39,465
Northern Star 4-11-----	42,210
Deltapine Smooth Leaf-----	44,170
Delfos 9169-----	41,948
Stoneville 7-A-----	39,988

1963 Field Tests, All varieties were defoliated before picking. Seed cotton lots representing six replications of the six different varieties were harvested on October 15, 1963. Table 5 gives the picking and picker efficiencies along with the ground, stalk, and preharvest losses. Lankart 57 had a very low preharvest loss, as it did in 1962. Four of the six varieties had picker efficiencies higher than 90 percent, as compared to 1962, when the highest picker efficiency was only 86 percent.

Table 5. Picker efficiency^{1/} and preharvest losses of cotton varieties in field tests, Stoneville, Miss., 1963

Test item	Lankart 57	Acala 4-42	Northern Star 4-11	Deltapine Smooth Leaf	Delfos 9169	Stoneville 7-A
Picker efficiency ^{2/} percent	88.6	88.1	91.2	95.3	93.5	93.7
Picker efficiency ^{3/} percent	87.3	86.2	89.9	91.6	90.5	89.1
Seed cotton, loss per acre:						
Ground-----pounds-----	132	236	129	75	114	120
Stalk-----do-----	131	37	74	40	35	40
Preharvest----do-----	32	57	33	101	102	69
Total-----do-----	295	330	236	216	251	229
Clean seed cotton:						
Yield per acre--pounds---	2030	2070	2110	2352	2392	2412
Yield per acre---bale---	1.44	1.45	1.50	1.65	1.70	1.73

1/ International Harvester 120-A cotton picker; average of 24 replicate lots.

2/ Considering ground and stalk losses.

3/ Considering ground, stalk, and preharvest losses.

Harvesting efficiencies were higher in 1963 than in 1962. Lankart 57 continued to have very little preharvest loss and a lower picker efficiency than the others as is shown in table 5. The Acala 4-42 variety produced more cotton than previously on a smaller stalk.

The average amount of force required to remove one lock of cotton was calculated for each variety. Coefficients of correlation were calculated to determine the relationship between carpel angle and force (table 6). Northern Star 4-11 was the only variety that showed any significant relationship between force and carpel angle.

The representative lots were ginned on October 16, 1963. The following machinery arrangement was used, multipath drier, 6-cylinder cleaner, unit stick remover, 6-cylinder cleaner, extractor-feeder, and double lint cleaning.

Table 6. Average peak force required to remove a lock of cotton compared with average carpel angle, picker efficiency, and preharvest loss, 1963 crop¹

Variety	Peak removal force	Carpel angle	Picker effi- ciency	Pre- harvest loss	Angle vs. force coefficient of correlation
	Grams	Degrees	Percent	lb./acre	Value
Stoneville 7-A	93.7	176.5	93.7	68.7	+0.674
Deltapine Smooth Leaf	78.3	174.4	95.3	100.6	- .804
Delfos 9169	91.6	173.4	93.5	101.5	- .286
Acala 4-42	88.7	166.6	88.1	56.8	- .856
Northern Star 4-11	107.5	167.8	91.2	33.3	- .610
Lankart 57	186.2	143.7	88.6	32.1	- .528

¹/ Ground and stalk losses were considered in the picker efficiency calculations.

Seed cotton foreign matter test results are summarized in table 7.

All the cottons responded favorably to the overhead cleaning. The total wagon sample foreign matter contents of the Stoneville 7-A, Delfos 9169, and Northern Star 4-11 varieties were somewhat higher than for the other three varieties. The grade-index values averaged 100.0 for Lankart 57, Acala 4-42, and Stoneville 7-A, while the Delfos 9169 had the lowest grade-index value of 94.0. The grade index value averaged 98.0 for Northern Star 4-11, and 96.0 for Deltapine Smooth Leaf (table 8).

⁴/ Cotton yields in bales per acre⁴ were as follows: Stoneville 7-A and Delfos 9169, 1.7; Deltapine Smooth Leaf, 1.6; Acala 4-42 and Northern Star 4-11, 1.5; and Lankart 57, 1.4. The highest picking efficiency was 95.3 percent for Deltapine Smooth Leaf, and the lowest was 88.6 for Lankart 57. Fiber data are also presented in table 8. Slightly longer staple lengths of 32.2 in 1/32-inch were associated with the Delfos 9169 and Stoneville 7-A varieties. The other four varieties were calssed 32.0 or an even 1 inch in staple length. Fiber strength ranged from a high of 92 (1,000 p.s.i.) for Acala 4-42 to a low of 72 for Lankart 57.

⁴/ Based on 1370 pounds of clean seed cotton per bale.

Table 7. Seed cotton foreign matter content of wagon and feeder samples pertaining to the 6 cotton varieties, 1963 crop.

Seed cotton foreign matter content	Lankart <u>57</u> ¹	Acala <u>4-42</u> ¹	Northern Star <u>4-11</u> ¹	Delta- pine Smooth Leaf ¹	Delfos <u>9169</u> ¹	Stone- ville <u>7-A</u> ¹	Average six var- ieties com- bined ²
Wagon sample:							
Hulls-----percent--	1.9	1.1	2.9	1.9	1.6	2.1	1.9
Sticks and stems-----do-----	.5	.4	.5	.5	1.3	.8	.7
Grass-----do-----	.4	--	--	--	.1	.2	.1
Large leaf---do-----	.5	1.1	.5	.6	1.0	1.0	.8
Small leaf---do-----	1.8	1.9	1.8	1.6	1.8	2.3	1.9
Pin trash---do-----	.2	.2	.1	.1	.2	.2	.2
Motes-----do-----	.2	.2	.1	.1	.1	.2	.2
Total all foreign matter--percent--	5.5	4.9	5.9	4.8	6.1	6.8	5.8
Feeder sample:							
Hulls-----percent--	--	--	0.1	--	0.2	0.1	0.1
Sticks and stems-----do-----	.2	.1	.2	.2	.1	.1	.2
Grass-----do-----	--	--	--	--	--	--	--
Large leaf---do-----	--	--	--	--	--	--	--
Small leaf---do-----	.2	.2	.2	.2	.2	.2	.2
Pin trash---do-----	.1	.1	.1	.1	.1	.1	.1
Motes-----do-----	.1	.1	.1	.1	.1	.1	.1
Total all foreign matter--percent--	0.6	0.5	0.7	0.6	0.7	0.6	0.7

1/ Figures are averages of 6 samples -- 2 for each of 3 replications.

2/ Figures are averages of 36 samples -- 6 for each of 6 varieties.

Table 8. Classification, moisture, foreign matter content of lint, yield, picking efficiency, and fiber data pertaining to the 6 cotton varieties, 1963 crop.¹

Test item	Lankart 57	Acala 4-42	Northern Star 4-11	Deltapine Smooth Leaf	Delfos 9169	Stoneville 7-A
Classification:						
Grade, index-----	100.0	100.0	98.0	96.0	99.0	100.0
Staple length, 1/32 inch-----	32.0	32.0	32.0	32.0	32.2	32.2
Moisture content, percent						
Wagon sample-----	7.0	7.2	6.7	6.6	6.9	7.2
Feeder sample-----	6.3	6.4	6.0	6.3	5.7	6.3
Lint sample-----	4.1	4.3	3.9	4.2	3.9	3.8
Foreign matter content of lint, percent-----	1.66	1.69	1.64	1.41	1.71	1.74
Cotton yield per acre, bale-----	1.4	1.5	1.5	1.6	1.7	1.7
Picking efficiency, percent ² -----	88.6	88.1	91.2	95.3	93.5	93.7
Fiber data						
Fibrograph span length						
50.0 percent, inches--	.44	.46	.43	.42	.41	.43
2.5 percent, inches--	.97	1.00	.98	1.01	1.06	1.04
Strength, "0" gage, 1,000 p.s.i.-----	72.0	92.0	79.0	82.0	76.0	87.0
Micronaire, reading-----	4.2	4.0	3.7	3.8	3.6	4.2

1/ Figures are averages of 6 samples, or 2 for each of 3 replications.

2/ Considering ground and stalk losses.

1964 Experiments

In the 1964 study, the plant populations 5 weeks after planting the six varieties were as follows:

Lankart 57-----	55,980
Acala 4-42-----	34,307
Northern Star 4-11-----	33,980
Deltapine Smooth Leaf-----	50,262
Delfos 9169-----	40,623
Stoneville 7-A-----	28,316

Field Tests. All varieties were defoliated before picking. The seed cotton lots representing six replications of each of the six different varieties were harvested October 6, 1964. Table 9 gives the picking and picker efficiencies along with the losses and the total yield. Again this year, four varieties had picker efficiencies higher than 90 percent.

Table 9. Picker efficiency^{1/} and preharvest losses of 6 cotton varieties in field tests, Stoneville, Miss., 1964 crop.

Test item	Lankart 57	Acala 4-42	Northern Star 4-11	Deltapine Smooth Leaf	Delfos 9169	Stone- ville 7-A
Picker efficiencies ^{2/} percent-----	88.0	92.1	88.7	93.7	95.0	92.9
Picker efficiencies ^{3/} percent-----	87.8	91.3	87.8	91.6	94.1	91.8
Seed cotton loss per acre:						
Ground-----pounds-----	136	94	126	96	88	104
Stalk-----do-----	178	84	148	72	54	92
Preharvest-----do-----	3	20	24	60	28	32
Total-----do-----	317	198	298	228	170	228
Clean seed cotton:						
Yield per acre--pounds---	2622	2224	2456	2768	2916	2796
Yield per acre---bales---	1.92	1.67	1.80	2.02	2.12	2.04

1/ John Deere 22 high-drum, 1-row picker; average of 24 replicate lots.

2/ Considering ground and stalk losses.

3/ Considering ground, stalk, and preharvest losses.

Analysis of variance and Duncan's multiple range test at the 95-percent level showed the following results: Significantly more cotton was left on the ground by the picker in Lankart 57 than in Delfos 9169, Acala 4-42, and Deltapine Smooth Leaf plots. Significantly more cotton was left on the stalk in Lankart 57 and Northern Star 4-11 than other varieties. Lankart 57 lost less cotton than all the other varieties before harvest, and Deltapine Smooth Leaf lost significantly more cotton than all the others before harvest.

The data in table 10 show some tendency toward a relationship between the force required to remove a lock of cotton and the picker efficiency and the carpel angle. No other trends are noticeable. Excellent harvesting conditions resulted in comparatively low preharvest loss for all varieties in 1964.

Table 10. Average peak force required to remove a lock of cotton compared with average carpel angle, picker efficiency, preharvest loss, average green boll diameter, and limb strength, 1964 crop.

Variety	Peak removal	Carpel angle	Picker effi-	Pre-	Green boll	Limb	Angle vs.
	force		ciency	harvest loss	diamete-	strength	force coef-
	Grams	Degrees	Percent	Lb./acre	Inches	Lb.	ficient of correlation
Stoneville 7-A----	70.71	164.7	92.9	32	1.35	10.56	-0.001
Deltapine Smooth Leaf-----	81.42	166.9	93.7	60	1.25	9.25	.002
Delfos 9169-----	83.94	153.4	95.0	28	1.34	9.56	.460
Acala 4-42-----	90.29	143.8	92.1	20	1.52	10.61	.687
Northern Star 4-11-----	119.09	139.4	88.7	24	1.40	10.21	-.248
Lankart 57-----	162.21	130.5	88.0	3	1.51	9.72	-.043

Seed cotton lots representing three replications of each of the six varieties were ginned in the pilot gin plant on October 8, 1964. The following machinery arrangement was used: Multipath drier, 6-cylinder cleaner, unit stick remover, 6-cylinder cleaner, extractor-feeder, and double lint cleaning. All of the cottons responded nicely to the cleaning, although more foreign matter was harvested with the Stoneville 7-A than with the other varieties (table 11).

Table 11. Seed cotton foreign matter content of wagon and feeder samples pertaining to the 6 varieties of cotton 1964 crop.

Seed cotton foreign matter content	Lankart 57 ¹ /	Acala 4-42 ¹ /	Northern Star 4-11 ¹ /	Delta-pine Smooth Leaf ¹ /	Delfos 9169 ¹ /	Stoneville 7-A ¹ /	Average six varieties combined ² /
Wagon sample:							
Hulls-----percent-----	0.8	0.6	0.9	1.0	0.9	1.2	0.9
Sticks and stems--do--	.1	.2	.2	.2	.3	.2	.2
Grass-----do-----	.1	.1	---	.1	---	.2	.1
Large leaf-----do--	.2	.2	.1	.1	.2	.2	.2
Small leaf-----do--	.7	.8	.8	.8	1.0	1.1	.9
Pin trash-----do--	.1	.1	.1	.1	.1	.1	.1
Motes-----do--	.6	1.1	.9	.6	.6	.9	.8
Total all foreign matter-----do--	2.6	3.1	3.0	2.9	3.1	3.9	3.2
Feeder sample:							
Hulls-----do--	---	---	---	---	0.2	0.1	---
Sticks and stems--do--	---	.2	---	.2	.1	.2	.1

Table 11. Seed cotton foreign matter content of wagon and feeder samples pertaining to the 6 varieties of cotton 1964 crop. (continued)

Seed cotton foreign matter content	Lankart 57 ^{1/}	Acala 4-42 ^{1/}	Northern Star 4-11 ^{1/}	Delta- pine Smooth Leaf ^{1/}	Delfos 9169 ^{1/}	Stone- ville 7-A ^{1/}	Average six var- ieties com bined ^{2/}
Grass-----percent-----	0.1	0.1	0.1	0.1	---	0.2	0.1
Large leaf-----do-----	---	---	---	---	---	---	---
Small leaf-----do-----	.1	.1	.1	.1	.2	.2	.1
Pin trash-----do-----	---	---	---	.1	.1	.1	.1
Motes-----do-----	.4	.4	.4	.3	.4	.3	.4
Total all foreign matter-----do-----	0.6	0.8	0.6	0.8	1.0	1.1	0.8

^{1/} Figures are averages of 6 samples or 2 for each of 3 replications.

^{2/} Figures are averages of 36 samples or 6 for each of 6 varieties.

There were no important differences in grade values, even though Lankart 57 had a higher lint foreign matter content than the other five varieties. Acala 4-42 and Delfos 9169 had grade index values of 99.0 as compared to 100.0 for the other four varieties (table 12). The averages staple length and fibrograph span length of Delfos 9169 was higher than for the other five varieties. Fiber strength (zero gage) ranged from a high of 87.0 (1,000 p.s.i.) for Acala 4-42 down to 75.7 for Lankert 57 and Delfos 9169.

Table 12. Classification, moisture, foreign matter content of lint, and fiber data pertaining to the 6 cotton varieties, 1964 crop.

Test item	Lankart 57	Acala 4-42	Northern Star 4-11	Deltapine Smooth Leaf	Delfos 9169	Stone- ville 7-A
Classification ^{1/}						
Grade-----index---	100.0	99.0	100.0	100.0	99.0	100.0
Staple length--1/32 in.	33.7	33.8	33.7	33.8	34.0	33.8
Moisture content ^{1/}						
Wagon sample--percent--	9.6	9.0	---	9.8	7.9	8.7
Feeder sample---do-----	8.6	7.9	7.8	8.4	7.9	8.0
Lint sample-----do-----	5.5	5.2	5.2	5.1	5.4	5.1
Foreign matter content of lint ^{1/} -----percent----- ^{2/}	2.34	2.11	2.07	1.83	2.17	2.21
Fiber data ^{1/}						
Fibrograph span length 2.5 percent----in.----	1.02	1.05	1.01	1.04	1.13	1.10
Uniformity ratio--percent	45.3	47.0	44.3	45.0	41.0	42.3
Strength, "0" gage 1,000 p.s.i.-----	75.7	87.0	81.7	79.0	75.7	78.0
Micronaire reading-----	4.5	4.4	4.3	4.5	4.1	4.4

^{1/} Figures are averages of 6 samples, or 2 from each of 3 replications.

^{2/} Figures are averages of 3 samples, or 1 from each of 3 replications.

Summary and Conclusions

Six varieties of cotton with varying characteristics were compared in a 3-year (1962-64) basic study of the most desirable plant characteristics for mechanical harvesting. The six varieties were Lankart 57, Acala 4-42, Northern Star 4-11, Deltapine Smooth Leaf, Delfos 9169, and Stoneville 7-A.

Although more foreign matter was harvested with Stoneville 7-A, ease of cleaning prevented any significant decrease in grade. Delfos 9169 produced the highest yield and highest picking efficiency, but was slightly lower in grade than the other five varieties.

There was a definite relationship between the average peak lock removal forces and machine efficiency, and between the peak lock removal force and preharvest loss. As the peak lock removal forces increased, picker efficiency and preharvest loss decreased. The highest peak lock removal forces (160.9 grams) were recorded with Lankart 57 and the lowest with Deltapine Smooth Leaf (86.0 grams). There were no significant differences between the picker efficiencies of Deltapine Smooth Leaf, Stoneville 7-A, and Delfos 9169, nor between the peak lock removal forces of these three varieties. The higher preharvest loss of Stoneville 7-A resulted in a low overall harvesting efficiency when compared to the actual machine efficiency for this variety.

There were no significant differences with respect to moisture content and staple lengths between varieties.

These results indicate that the three Delta varieties -- Deltapine Smooth Leaf, Delfos 9169, and Stoneville 7-A -- are the best choices among those tested for spindle picking in the Mississippi Delta. However, there is a need for a variety having fairly short, compact stalks (3 to 4 feet high) without low hanging limbs. This would prevent the incidence of boll contact with the ground. Also needed is a variety with moderate storm resistance and an average peak removal force of approximately 100 grams. Bolls should be located close to the main stalk and should be fairly evenly distributed.

It is obvious that several of the foregoing descriptions are still quite general or qualitative. In cooperation with biological scientists, work is continuing on more refined measurements of boll and plant characteristics that may be of value to future breeding programs and harvester design.

A summary of the wagon and feeder sample foreign matter content data for the 3 years combined is given in table 13.

The 3-year summary of other factors, such as cotton yield, picker efficiency, grade, etc. is presented in table 14

Table 13. Seed cotton foreign matter content of wagon and feeder samples pertaining to the 6 varieties of cotton, 1962, 1963, and 1964 crops combined.

Seed cotton foreign matter content	Lankart 57 ^{1/}	Acala 4-42 ^{1/}	Northern Star 4-11 ^{1/}	Delta- pine Smooth Leaf ^{1/}	Delfos 9169 ^{1/}	Stone- ville 7-A ^{1/}	Average six var- ieties com- bined ^{2/}
Wagon sample:							
Hulls-----percent--	1.6	0.9	1.8	1.7	1.5	1.9	1.6
Sticks and stems-----do-----	.3	.3	.4	.4	.7	.5	.4
Grass-----do-----	.3	.1	.1	.2	.2	.3	.2
Large leaf--do-----	.4	.7	.4	.5	.7	.6	.6
Small leaf--do-----	1.3	1.4	1.3	1.1	1.4	1.6	1.4
Pin trash--do-----	.5	.4	.4	.5	.5	.6	.5
Motes-----do-----	.4	.6	.5	.4	.4	.6	.5
Total all foreign matter---percent-	4.8	4.4	4.9	4.8	5.4	6.1	5.2
Feeder sample:							
Hulls-----percent--	---	---	0.1	0.1	0.2	0.1	0.1
Sticks and stems-----do-----	.1-	.2	.1	.1	.2	.2	.2
Grass-----do-----	.1	.1	.1	.1	.1	.2	.1
Large leaf--do-----	---	---	---	.1	.1	---	---
Small leaf--do-----	.3	.3	.3	.2	.3	.4	.3
Pin trash--do-----	.1	.1	.1	.1	.2	.2	.1
Motes-----do-----	.2	.2	.2	.2	.2	.2	.2
Total all foreign matter---percent-	0.8	0.9	0.9	0.9	1.3	1.3	1.0

^{1/} Figures are averages of 18 samples for 6 for each of 3 years.

^{2/} Figures are averages of 108 samples for 18 for each of 6 varieties.

Table 14. Summary of factors studied in mechanical harvesting and ginning of 6 commercial cotton varieties at Stoneville, Miss., 1962-64 crop.

Test item	Lankart 57	Acala 4-42	Northern Stan 4-11	Deltapine Smooth Leaf	Delfos 9169	Stone- ville 7-A
Yield:						
Clean seed cotton pounds per acre-----	2183	2095	2291	2519	2551	2438
Actual machine effi- ciency----percent ^{1/} ---	83.3	87.0	86.7	90.3	91.5	89.6
Harvesting efficiency, percent ^{2/} -----	81.8	83.0	83.5	85.7	86.8	83.8
Preharvest loss, percent-----	---	3.1	2.4	4.5	4.5	5.6
Wagon sample:						
Foreign matter content, percent-----	4.6	4.3	4.7	4.7	5.1	5.9
Foreign matter content of lint---percent-----	1.79	1.71	1.77	1.61	1.96	1.95
Grade classification, index ^{3/} -----	99.3	99.0	98.7	98.3	95.7	99.0
Lock removal forces, grams-----	160.9	96.8	114.5	86.0	94.4	89.5

1/ Machine efficiency considers only ground and stalk losses during picking.

2/ Harvesting efficiency is the percent of total yield gathered by the picker.

3/ Grade index of 100 is Middling; 94 equals Strict Low Middling.